GBE1 gene

1,4-alpha-glucan branching enzyme 1

Normal Function

The *GBE1* gene provides instructions for making the glycogen branching enzyme. This enzyme is involved in the last step of the production of a complex sugar called glycogen, which is a major source of stored energy in the body. Glycogen is made up of many molecules of a simple sugar called glucose; some glucose molecules are linked together in a straight line, while others branch off the main line and form side chains. The glycogen branching enzyme is involved in the formation of these side chains. The branched structure of glycogen makes it more compact for storage and allows it to break down more easily when it is needed for fuel.

Health Conditions Related to Genetic Changes

adult polyglucosan body disease

At least three mutations in the *GBE1* gene have been found to cause adult polyglucosan body disease, a condition that affects the nervous system. These mutations change single protein building blocks (amino acids) in the glycogen branching enzyme. One mutation appears to be more common in affected people with Ashkenazi Jewish ancestry. This mutation replaces the amino acid tyrosine with the amino acid serine at position 329 in the enzyme (written Tyr329Ser or Y329S). Most mutations that cause adult polyglucosan body disease lead to a shortage (deficiency) of the enzyme. As a result, glycogen has fewer side chains. These abnormal glycogen molecules, called polyglucosan bodies, accumulate within cells and cause damage. Nerve cells (neurons) appear to be particularly vulnerable to the accumulation of polyglucosan bodies in this disorder. Damage to neurons causes reduced sensation, weakness, and other nervous system problems in people with adult polyglucosan body disease.

glycogen storage disease type IV

Approximately 40 mutations in the *GBE1* gene have been found to cause glycogen storage disease type IV (GSD IV). This disorder is characterized by liver and muscle problems that usually begin in infancy and are caused by a buildup of abnormal glycogen. Most of the mutations that cause this condition change single amino acids in the glycogen branching enzyme. The *GBE1* gene mutations that cause GSD IV lead to a severe shortage or complete absence of glycogen branching enzyme. As a result, polyglucosan bodies accumulate in cells, leading to damage and cell death. Polyglucosan bodies build up in cells throughout the body, but liver cells and

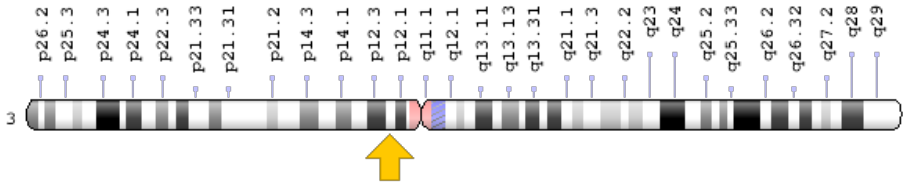
muscle cells are most severely affected in GSD IV. Glycogen accumulation in the liver interferes with liver functioning, causing an enlarged liver and liver disease. The inability of muscle cells to break down glycogen for energy leads to muscle weakness and wasting.

It is unclear why liver and muscle cells are affected by the accumulation of polyglucosan bodies in GSD IV, while neurons are solely affected in adult polyglucosan body disease (described above).

Chromosomal Location

Cytogenetic Location: 3p12.2, which is the short (p) arm of chromosome 3 at position 12.2

Molecular Location: base pairs 81,489,699 to 81,761,799 on chromosome 3 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- amylo-(1,4 to 1,6) transglucosidase
- amylo-(1,4 to 1,6) transglycosylase
- GBE
- GLGB_HUMAN
- glucan (1,4-alpha-), branching enzyme 1
- glycogen branching enzyme

Additional Information & Resources

Educational Resources

- Basic Neurochemistry (sixth edition, 1999): Lafora and Other Polyglucosan-Storage Diseases
  https://www.ncbi.nlm.nih.gov/books/NBK28028/#A2970
- Washington University, St. Louis Neuromuscular Disease Center
  http://neuromuscular.wustl.edu/msys/glycogen.html#branch

GeneReviews

- Adult Polyglucosan Body Disease
  https://www.ncbi.nlm.nih.gov/books/NBK5300
- Glycogen Storage Disease Type IV
  https://www.ncbi.nlm.nih.gov/books/NBK115333

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28GBE1%5BTIAB%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+2160+days%22%5Bdp%5D

OMIM

- GLYCOGEN BRANCHING ENZYME
  http://omim.org/entry/607839

Research Resources

- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=GBE1%5Bgene%5D
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=4180
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/2632
- UniProt
  http://www.uniprot.org/uniprot/Q04446

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https://ghr.nlm.nih.gov/gene/GBE1

Reviewed: February 2013
Published: March 21, 2017

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